

Biology and Management of Fusarium Wilt of Lettuce in Arizona

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Abstract

*Fusarium wilt presents a serious threat to the health of the lettuce industry in Arizona. The objective of this research program is to begin to develop a greater understanding of the biology of *Fusarium oxysporum* f.sp. *lactucae* and the wilt disease that it causes in commercial lettuce fields. In the 2001-2002 production season, *Fusarium* wilt was observed for the first time in six different lettuce fields in the Gila and Dome Valley production areas of Yuma County, Arizona. The disease was found in 11 additional sites during 2002-2003. The relative resistance of lettuce cultivars grown in the Arizona desert production region is unknown; therefore, a cultivar evaluation trial was established in a field known to contain the wilt pathogen. Tested cultivars were grouped into three different planting dates: Sep 7, Oct 17 and Dec 6, 2002. A majority of the cultivars within each planting date were those that would be planted in the desert at that time. Among the types of lettuce tested, head lettuce was usually least resistant whereas romaine was most resistant. *Fusarium* wilt was severe in the early planting of lettuce (Sep 7), moderate in the second planting (Oct 17) and very mild in the third planting (Dec 6). One possible reason for the differences in disease severity among planting dates was soil temperature. The average daily soil temperature at the 4-inch depth ranged from 65 to 85°F, 55 to 74°F, and 48 to 64°F for the first, second and third plantings, respectively. Tests to evaluate fungicides for management of *Fusarium* wilt were inconclusive due to very low levels of disease. The data presented in this report are preliminary findings, subject to confirmation in further research planned for the next lettuce production season.*

Introduction

In the fall of 2001, a new disease was observed in six different lettuce fields in the Gila and Dome Valley production areas of Yuma County, Arizona. Symptoms included wilting, yellowing of leaves and a red-brown to black discoloration of internal taproot and crown tissue. Affected plants were stunted and often died. This wilt disease affected lettuce plants of all ages, from seedling to mature plant. A *Fusarium* species was consistently recovered from discolored internal taproot and crown tissue.

Fusarium wilt is new to Arizona lettuce fields; however, the disease was first discovered on this crop in Japan in 1955. The first discovery of *Fusarium* wilt of lettuce in the United States occurred during 1990 in Fresno County near Huron, California. Most recently, the disease was reported in Italy in 2002. Researchers in Japan named the pathogen *Fusarium oxysporum* f.sp. *lactucae*. This fungus is a soil-borne pathogen that can remain viable in soil for many years.

A research paper published in 1993 by Hubbard and Gerik (1) is the current primary source of information concerning the disease cycle and epidemiology of *Fusarium* wilt of lettuce. Hubbard and Gerik determined in the laboratory that the fungus can grow between 46 and 89°F, with optimum growth at 82°F. Lettuce was not susceptible to any of the *Fusarium* wilt pathogens from other crops, including tomatoes and melons. Likewise, no other hosts have been found for *Fusarium oxysporum* f.sp. *lactucae*. In seedling inoculation experiments, the researchers found that the lettuce cultivars Autumn Gold, Empire, Excell, Salinas, Vanguard, Vanguard 75, Vanmax, Viva and

Winterset were susceptible to the disease in varying degrees, with Salinas demonstrating the most disease tolerance.

Fusarium wilt presents a serious threat to the health of the lettuce industry in Arizona. The overall objective of this research program is to begin to develop a greater understanding of the biology of *Fusarium oxysporum* f.sp. *lactucae* and the wilt disease that it causes in commercial lettuce fields in Arizona. The specific objectives are to 1) survey lettuce fields to determine where the Fusarium wilt pathogen is located, 2) evaluate lettuce cultivars for relative susceptibility to Fusarium wilt, 3) determine the range of soil temperatures that are conducive to disease development, and 4) evaluate selected fungicides as potential management tools for Fusarium wilt on lettuce.

Materials and Methods

Survey of lettuce fields for Fusarium wilt. Cooperators, including growers, pest control advisors and other lettuce industry personnel examined lettuce fields and collected plants suspected of being affected with Fusarium wilt. In the laboratory, discolored root cortex tissue from suspect plants was plated onto potato dextrose agar medium. Plants were considered positive for Fusarium wilt if the pathogen *Fusarium oxysporum* f.sp. *lactucae* emerged from this symptomatic root tissue.

Evaluation of lettuce cultivars for relative susceptibility to Fusarium wilt. A large field trial was established on a commercial lettuce field farmed by Coronation Peak Ranches in Wellton, Arizona. Plots were planted and managed using current commercial practices. Each of the four replicate plots for each head lettuce cultivar contained 600 lettuce plants for a total of 2,400 plants evaluated per cultivar. For romaine and leaf lettuce cultivars, replicate plots each contained 300 plants for a total of 1,200 plants evaluated per cultivar. Tested cultivars were grouped into three different planting dates: Sep 7, Oct 17 and Dec 6, 2002. A majority of the cultivars within each planting date were those that would be planted in the desert at that time. The remainder of the cultivars were included for comparison of disease on the same cultivar within different planting dates or for evaluation of cultivars not grown commercially in the desert. Termination dates for each planting and the number of cultivars of each lettuce type within each planting are listed in Table 1. Disease evaluations were performed three times during crop development in each planting. Only the final disease rating at crop maturity is presented in this report. Each plant within a plot was determined to be diseased if the plant was dead or stunted and displayed the typical wilting and yellowing symptoms of Fusarium wilt of lettuce.

Table 1.

Planting number	Planting date	Maturity date	Days to maturity	Number of cultivars tested of each lettuce type.				
				Head	Romaine	Green leaf	Red leaf	Butter
1	Sep 7	Nov 8	62	41	15	3	4	2
2	Oct 17	Jan 11	86	40	9	4	3	----
3	Dec 6	Mar 22	107	40	4	1	1	1

Determination of the range of soil temperatures that are conducive to disease development.

Some cultivars in the field trial described above will be grown in two and sometimes all three planting dates. Soil temperature at the 4-inch depth will be monitored throughout all three trials. Disease incidence and severity among the different planting dates will be compared to soil temperatures to determine the potential effect of temperature on resultant severity of Fusarium wilt.

Evaluation of selected fungicides for control of Fusarium wilt on lettuce. There are a few fungicides that have activity against *Fusarium* and may provide some level of disease suppression. To evaluate these chemistries, plots were established in a randomized complete block design. The first application of materials was applied to soil after seeding and before the first irrigation. A second application was made 4 weeks later. Products evaluated included Medallion, Pristine and Topsin M. Control plots were not treated with a fungicide..

Results and Discussion

Survey of lettuce fields for Fusarium wilt. Fusarium wilt was first recognized in the Yuma area during the 2001-2002 season, when *Fusarium oxysporum* f.sp. *lactucae* was recovered from diseased head lettuce plants in six different fields. During the just completed 2002-2003 season, the pathogen was recovered from 11 additional head lettuce plantings. Disease was detected in these fields from October through December; therefore, head lettuce fields in production during this time that exhibited no evidence of Fusarium wilt can be assumed to be free of the pathogen. On the other hand, lettuce fields in production during January through March and showing no evidence of Fusarium wilt still may harbor the pathogen, since disease development during this time is greatly reduced and could be overlooked.

Evaluation of lettuce cultivars for relative susceptibility to Fusarium wilt. The complete list of tested lettuce cultivars and their respective disease assessments at crop maturity are presented in Table 2 of a related report entitled "Evaluation of lettuce cultivars for resistance to Fusarium wilt." Several cultivars were present in two and occasionally in all three plantings, which allowed for comparison of disease intensity among different planting dates. In all three plantings, differences in disease severity were detected among the different types of lettuce, with head lettuce being most susceptible whereas romaine demonstrated the highest level of tolerance. Observed disease tolerance for specific cultivars was dependent on disease pressure. Of the 11 head lettuce cultivars tested in both the first (high disease pressure) and second (moderate disease pressure) plantings, the lowest disease rating was a 32% loss in the first planting, whereas three head lettuce cultivars had disease ratings at or below 4% in the second planting. Similar results were observed for romaine, green leaf and red leaf lettuce.

Determination of the range of soil temperatures that are conducive to disease development.

Among virtually all tested cultivars of lettuce, the severity of disease in the first planting was much higher than that observed in the second planting, which in turn was higher than that observed in the third planting. One possible reason for the differences in severity of Fusarium wilt among planting dates was soil temperature. The average daily soil temperature at the 4-inch depth ranged from 65 to 85EF, 55 to 74EF, and 48 to 64EF for the first, second and third plantings, respectively.

Evaluation of selected fungicides for control of Fusarium wilt on lettuce. The first two trials were conducted in soil that was artificially infested with the pathogen and the final trial was placed in the same field as the cultivar evaluation study. Disease severity in each of the three runs of this trial was too low for meaningful comparisons of treatments.

Recommendations

Keeping in mind that the data presented in this report are preliminary findings and subject to confirmation by further studies, there are some recommendations that can be made concerning the management of *Fusarium* wilt of lettuce.

1. Every effort should be made to prevent the spread of contaminated soil from known locations of *Fusarium oxysporum* f.sp. *lactucae* to “clean” fields by workers and equipment. These precautions should be maintained even when crops other than lettuce are grown in infested fields.
2. Avoidance. The best way to avoid *Fusarium* wilt on lettuce is to not plant this crop on sites known to contain the pathogen.
3. Based on the preliminary data presented in this report, one could choose a late planting date (early December) and select a cultivar that sustained little to no disease at this planting time.
4. For the vast majority of lettuce production fields where *Fusarium oxysporum* f.sp. *lactucae* is not known to occur, maintain vigilance to prevent the introduction of the pathogen into your fields and use your normal criteria for cultivar and planting time selection.

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Reference

Hubbard, J.C., and Gerik, J.S. 1993. A new wilt disease of lettuce incited by *Fusarium oxysporum* f.sp. *lactucum* forma specialis nov. Plant Dis. 77:750-754.